ARC Training Centre for M3D Innovation

PhD Scholarship

Partnership between:
Defense Science and Technology Group (DSTG), Melbourne and the Australian National University (ANU), Canberra

The **ARC Training Centre for Multiscale 3D Imaging, Modelling and Manufacturing (M3D)** will train a new generation of PhD candidates in the emerging area of Digital Materials and Advanced Manufacturing. Projects within the M3D Training Centre are run in collaboration with our industry partners from Australia and overseas and promise to deliver real-world outcomes with ground-breaking results within diverse fields. The program will give PhD candidates a chance to obtain practical experience through industry-based research training with the relevant industry partner. Visit: https://m3d.edu.au

3D imaging of samples through Computed Tomography with sub-millimetre resolution (micro-CT) forms the core investigative tool of the M3D Innovation ARC Training Center. This capability is to be provided by CTLab at ANU as well as the imaging beamlines at ANSTO. These non-destructive, 3D imaging capabilities are ideal for inspection of components fabricated by metallic additive manufacturing (3D printing). It is particularly important for quality control of safety-critical aerospace components as being investigated by DSTG. A student project that arises from the collaboration is:

X-Ray Scatter Correction for Additive Manufacturing Inspection

This could involve all aspects of instrumentation from hardware and acquisition protocols, to developing computational imaging and tomographic reconstruction algorithms, as well as 3D image analysis techniques. (Full Project Descriptions Attached)

DSTG will provide a $10,000/year top-up to a PhD Scholarship. Candidates must hold a First Class Bachelor degree with Honours or a Master degree in Material or Mechanical Engineering, Mathematics, Physics, Materials Science, Computer Graphics, Visualisation, or in a related field of research. Knowledge of programming, modelling or image processing is desirable.

Applications close 31 May 2021 or until the position is filled.

Applications and further information:
M3D Innovation Enabling Technology Leader: Dr Andrew Kingston,
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Information about ANU positions:
M3D Innovation Centre Manager:
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Resources | Non-destructive Evaluation | Medical Devices | High Value Materials | Heritage Science/Arts | Energy & Environment

X-Ray Scatter Correction for Additive Manufacturing Inspection

Primary Supervisors: Dr Chris Wood (DSTG), Dr Jon Miller (USAF)

Non-destructive evaluation of safety-critical AM components prior to installation is crucial to identify any defects in the fabrication process and determine if the size/shape/location (i.e., characteristics) of these defects has the potential to cause part failure. DSTG has developed sophisticated modeling techniques and performed failure tests to understand the effect of defect characteristics under use conditions of AM components; they have determined standards on minimum defect sizes. The effectiveness of non-destructive evaluation relies on the quality of the 3D imaging process by X-ray Computed Tomography (XCT).

The focus of this project is to develop techniques to provide the highest quality XCT data for evaluation. The most- practical candidate for imaging metallic AM components is lab-based X-ray CT. However, metal objects have many non-ideal interactions with X-rays that cause unwanted effects in the images produced (called artefacts) such as streaking and smearing, and generally cause degradation of image quality.

This project will build on ANU expertise in lab-based X-ray CT scanning and tomographic image reconstruction. To date X-ray scatter has largely been ignored by the X-ray CT community since it is typically a secondary effect. However, when imaging metal objects, it produces the most significant artifacts. The primary research goal of this project is to develop techniques to deal with X-ray scatter. This will be approached from three directions:

1) Scatter rejection through X-ray beam collimation

2) Scatter measurement through the use of patterned illumination techniques such as beam-stop-arrays

3) Modeling of elastic and inelastic X-ray scatter mechanisms by techniques such as Monte-Carlo simulation and deep-learning (e.g. [1]). Such models can be placed into the forward process of the iterative reconstruction scheme employed by ANU to better simulate the measured data.

[1] Maier, J., et al. Deep Scatter Estimation (DSE): Accurate Real-Time Scatter Estimation for X-Ray CT Using a Deep Convolutional Neural Network. J Nondestruct Eval 37, 57 (2018).

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